

Directive 001

Release date: June 6, 2012

Effective date: June 6, 2012

Replaces previous edition issued September 20, 2005.

Requirements for Site-Specific Liability Assessments in Support of the ERCB's Liability Management Programs

The Energy Resources Conservation Board (ERCB/Board) has approved this directive on May 28, 2012.

<original signed by>

Dan McFadyen
Chairman

Contents

1	Introduction	2
1.1	Purpose of This Directive	2
1.2	What's New in This Edition	2
2	Initiation of a Liability Assessment	3
2.1	Voluntary Submission of a Site-Specific Liability Assessment	3
2.2	ERCB-Required Submission of a Site-Specific Liability Assessment	3
2.2.1	Potential Problem Site	3
2.2.2	Oilfield Waste Management Facilities	4
3	Scope of a Liability Assessment	4
4	Applicable Assessment Standards	4
4.1	Suspension and Abandonment	4
4.2	Reclamation	4
5	Estimating Costs	5
5.1	Suspension Costs	5
5.2	Abandonment Costs	5
5.3	Reclamation Costs	6
5.3.1	Remediation Costs	6
5.3.2	Surface Reclamation Costs	6
6	Other Reporting Requirements	7
6.1	Conditions Affecting Scope or Accuracy	7
6.2	Noncompliance Conditions	7
6.3	Roles and Qualifications of Personnel	7
6.4	Certification of Work	7
7	Submitting an Existing Liability Assessment	8
8	Use of a Liability Assessment	8
9	Updates of Site-Specific Liability Assessment Cost Estimates	8

Appendix 1	Tasks for Estimating Site-Specific Costs	9
A1.1	Estimating Project Management and Administration Costs	9
A1.2	Estimating Suspension Costs	9
A1.3	Well Suspension	9
A1.4	Facility Suspension	9
A1.5	Pipeline Suspension or Discontinuation	10
A1.6	Estimating Abandonment Costs	10
A1.7	Estimating Reclamation Costs	11
Appendix 2	Requirements for Site-Specific Liability Assessments for the Large Facility	
	Liability Management Program	12
A2.1	Introduction	12
A2.2	Suspension and Abandonment	12
A2.3	Phase I Environmental Site Assessment	13
A2.4	Phase II Environmental Site Assessment	13
A2.5	High-Level Overview for Using Phase II Investigations	13
A2.6	Soil Volume Plume Determination for Accessible Areas	13
A2.7	Estimating Affected Soil Volumes If Site Structures Do Not Allow Safe Work	14
A2.8	Unaffected Overburden and Topsoil	15
A2.9	Groundwater Issues	16
A2.10	Groundwater Plume Determination	16
A2.11	Remediation Plan	17
A2.12	Summary of Documents to Be Submitted to ERCB	18

1 Introduction

1.1 Purpose of This Directive

This Energy Resources Conservation Board (ERCB) directive sets out the requirements for site-specific liability assessments. A “liability assessment” is an assessment conducted by a licensee or approval holder to estimate the cost to suspend, abandon, or reclaim a site. These requirements are to be applied for all liability management programs administered by the ERCB. In addition, Appendix 2 contains specific requirements for site-specific liability assessments acceptable for the Large Facility Liability Management Program. The approach and documentation specified in this directive are introduced to improve the consistency and accuracy of liability cost estimates submitted to the ERCB. They do not modify requirements concerning how suspension, abandonment, and reclamation activities are to be conducted.

1.2 What's New in This Edition

The following has been removed from Section 8 (previously Section 7):

The duration that each deemed liability will remain acceptable to the EUB will depend primarily upon the rate at which site conditions are expected to change. It is anticipated that most assessments will remain in effect for approximately three years, unless site conditions or subsequent operations warrant a more or less frequent assessment schedule.

A new section, Section 9: Updates to Site-Specific Liability Assessment Cost Estimates, has been added. This section sets out the requirements for submitting updated site-specific liability assessment cost estimates.

2 Initiation of a Liability Assessment

A licensee or approval holder may voluntarily conduct and submit a site-specific liability assessment to the ERCB or they may be required to do so by the ERCB in support of liability management programs.

2.1 Voluntary Submission of a Site-Specific Liability Assessment

Directive 006: Licensee Liability Rating (LLR) Program and Licence Transfer Process established the LLR Program, which assesses the financial viability of a licensee based on the ratio of its deemed assets to its deemed liability. The estimated abandonment and reclamation costs used in determining the deemed liability in the LLR are average values developed with industry input. Appendix 8 of *Directive 006* identifies three situations where a licensee, subject to financial security deposits, may initiate a site-specific liability assessment to permit a more accurate assessment of those deemed liabilities. This voluntary process is available only to a licensee with an LLR less than the deposit threshold currently set at 1.0. To use this provision, a licensee must submit separate liability assessments for each of its facilities or each of its wells to ensure that the review is complete and does not assess just selected low-cost sites.

A licensee may conduct an assessment of the

- abandonment liability of a facility if the average abandonment estimate determined by the ERCB's Facility Well Equivalents Table (*Directive 006*, Appendix 6) is believed to be higher than expected costs;
- reclamation liability of a facility if the average reclamation estimates determined by the ERCB's Regional Reclamation Cost Map (*Directive 006*, Appendix 12) and Facility Well Equivalents table are believed to be higher than expected costs; and
- reclamation liability of a well if the average reclamation estimate determined by the ERCB's Regional Reclamation Cost Map is believed to be higher than expected costs.

2.2 ERCB-Required Submission of a Site-Specific Liability Assessment

2.2.1 Potential Problem Site

A licensee may be required by the ERCB to use the methodology specified in this directive to conduct a site-specific assessment of expected reclamation costs of a potential problem site: a site expected by the ERCB to have a reclamation cost at least four times greater than the deemed reclamation liability normally calculated for a site of that type in that region of Alberta. The deemed reclamation liability applied in the LLR is normally calculated using the Facility Well Equivalents Table (*Directive 006*, Appendix 6), or the Regional Reclamation Cost Map (*Directive 006*, Appendix 12), as may be amended from time to time.

Conditions that may result in a site being identified by the ERCB as a potential problem site include

- insufficient recovery of spilled or released produced fluids or oilfield waste,
- significant off-lease damage to soil, vegetation, or a water body,
- evidence or high probability of groundwater contamination, and
- extraordinary surface reclamation issues, such as an extensive cut and fill.

A site-specific liability assessment of a potential problem site is used to modify the deemed reclamation liability applied in the LLR calculation. Where site-specific reclamation costs are

estimated to be more than four times the normal deemed reclamation cost applied in the LLR, the site will be classified as a designated problem site. That designation will be applied until reclamation work has been conducted and a subsequent liability assessment acceptable to the ERCB indicates that the reclamation cost is estimated to be less than four times the normal reclamation liability applied in the LLR.

2.2.2 Oilfield Waste Management Facilities

Guide 58: Oilfield Waste Management Requirements for the Upstream Petroleum Industry introduced financial security deposit requirements for ERCB-approved oilfield waste management facilities. *ID 2001-04: Financial Security for Oilfield Waste Management Facilities* provided details of those requirements. Stage 2 of the program described in that ID requires ERCB approval holders to conduct site-specific assessments of suspension and abandonment costs of those facilities by September 15, 2004. Stage 3 requires an update of those estimates plus assessment of site-specific reclamation costs by September 1, 2006. This directive specifies the approach and documentation for conducting liability assessments of oilfield waste management facilities and supplements the requirements of *ID 2001-04*.

3 Scope of a Liability Assessment

In estimating suspension, discontinuation, or abandonment costs, an evaluation of the development licensed or approved by the ERCB, as well as the infrastructure and supporting equipment included in that authorization, must be conducted.

In estimating reclamation costs, all land or water directly affected by the construction, operation, or abandonment of the development licensed or approved by the ERCB must be assessed. Licensees should be aware that all facilities, infrastructure, and equipment included in an ERCB licence or approval require a reclamation certificate. This includes access roads, remote drilling waste sumps, land treatment areas, borrow pits, earthen structures, warehouses, campsites, lay-down areas, storage areas, bone yards, and air strips. For sites not eligible for a reclamation certificate, a plan to complete an equivalent degree of remediation and reclamation is required in order to estimate the associated costs.

4 Applicable Assessment Standards

4.1 Suspension and Abandonment

An assessment of suspension or abandonment costs must be based on a site-specific plan to meet or exceed applicable ERCB requirements (including *Guide 20: Well Abandonment Guide* and *Guide 59: Well Drilling and Completion Data Filing Requirements*) using generally accepted engineering practice.

4.2 Reclamation

Remediation and surface reclamation issues must be identified and initially evaluated through a phase I environmental site assessment conducted in a manner that meets or exceeds the standards provided in Alberta Environment and Sustainable Resource Development (ESRD) publication *T/573: Phase I Environmental Site Assessment Guideline for Upstream Oil and Gas Sites*. The phase I report is to document and evaluate historical development and current site conditions in order to identify significant remediation and surface reclamation issues warranting further assessment. The phase I assessment is also to compile site-specific data needed to develop a surface reclamation plan and estimate associated costs. If historical files

or similar data are not available, the significance of the missing information must be evaluated and, where appropriate, a contingency amount provided in the cost estimate.

Contaminant and similar environmental issues warranting further assessment identified in the phase I report must be further evaluated and documented in a detailed report prepared in a manner that meets or exceeds standards provided in *Canadian Standards Association (CSA) Standard Z769-00: Phase II Environmental Site Assessment*. The phase II assessment is to evaluate the significance of the issues identified in the phase I report and, where needed, quantify their effects. The phase II assessment is to compile additional site-specific data needed to develop a remediation plan and estimate associated costs. If some liability issues cannot be sufficiently evaluated, the significance of the missing information must be evaluated and, where appropriate, a contingency amount provided in the cost estimate. A complete, signed copy of the phase I report, including field notes and contact prints or laser photocopies of aerial photographs, must be submitted to the ERCB with the phase II assessment report.

The ERCB may waive the requirement for a phase II environmental site assessment if a thorough and fully documented phase I assessment demonstrates that there are no significant environmental issues warranting further assessment. In those circumstances, all other requirements and standards specified in this document will apply.

5 Estimating Costs

An estimate of costs to address currently outstanding suspension, abandonment, or reclamation obligations must be based on a site-specific assessment as described above. A cost estimate must be developed as if a third party were conducting the work and supplying the necessary equipment. A cost estimate must be itemized and clearly show the subtotals for all major tasks. The associated unit rates must be based upon standard or published prices for all services. Price discounts available to all parties may be applied, but client-specific discounts, such as those for preferred client status or coordinated regional cleanups of multiple sites, may not be applied. A cost estimate must not apply a net present value for work to be conducted in the future. For a site included within the scope of the Orphan Fund, as described in Appendix 1 of *Directive 006*, credit for salvage value is not to be included, as salvage value is taken into consideration through the present value and salvage (PVS) factor applied in the LLR. Appendix 1 of this directive summarizes the primary tasks to be evaluated by the ERCB when reviewing a site-specific liability assessment.

5.1 Suspension Costs

An estimate of site-specific suspension costs must provide for three years of care, custody, and security of the well, facility, or pipeline.

5.2 Abandonment Costs

An estimate of site-specific abandonment costs must provide for the downhole and surface abandonment of a well, the decommissioning and dismantling of a facility, or the abandonment of a pipeline in a manner that meets or exceeds all ERCB requirements. The cost estimate must itemize tasks and estimate costs to ensure that the well, facility, or pipeline is left in a permanently safe and secure condition. Abandonment costs of pipelines must indicate whether the pipe is being abandoned in place or removed.

5.3 Reclamation Costs

An estimate of reclamation costs must provide for both the remediation and surface reclamation of all land directly affected by the development in order to obtain a reclamation certificate in a predictable, expedient manner. For a site not eligible to obtain a reclamation certificate, a cost estimate to complete a comparable degree of remediation and surface reclamation is required.

The licensee or approval holder of a site where reclamation certification does not appear to be technically feasible is encouraged to contact the ERCB's Liability Management Section at 403-297-3113 for further guidance in estimating costs.

5.3.1 Remediation Costs

An estimate of remediation costs must be based on a remediation approach that has been demonstrated effective in Alberta in sufficiently treating affected soil or water so that a site may become eligible for a reclamation certificate. The remediation plan employed for costing purposes must not result in residual contamination being left in place that would restrict subsequent land capability relative to previous land use. Where contaminants cannot be excavated, the time and costs to actively remediate residual contamination in place must be estimated and supporting documentation provided. The remediation cost estimate must be based on a remediation plan that

- excavates, to the extent possible, all affected soil and subsoil in order to meet or exceed applicable guidelines;
- treats or disposes of oilfield waste at approved waste management facilities or, where oilfield waste and site characteristics warrant, follows ERCB requirements for on-site oilfield waste management; and
- treats affected water, groundwater, bedrock, and inaccessible soil contamination to meet applicable guidelines, criteria, or standards.

Conversion of an in-place estimated volume of affected soil to a mass of material requiring transportation to an approved waste management facility is a critical factor that may greatly influence estimated remediation costs. When estimating costs to dispose of affected material off site, soil density must be measured in situ (in place) and not be based upon typical values or laboratory assessment of bulk density. As a minimum, in situ soil density must be measured for the most dense soil type encountered, and the method used to assess it must be described. Soil density need not be assessed if costs are estimated for on-site treatment of affected soil.

5.3.2 Surface Reclamation Costs

An estimate of surface reclamation costs must be based on an approach that returns the ability of the land to support land uses that are similar, but not necessarily identical, to that which existed before development of the site. This includes stabilization, contouring, conditioning, reconstruction, revegetation, and maintenance of the land and removal of the access road and directly related infrastructure (cattle guards, culverts, or bridges). If applicable, costs must also include all administrative and related tasks needed to obtain a reclamation certificate, such as a detailed site assessment, certificate application, and on-site inspection.

6 Other Reporting Requirements

6.1 Conditions Affecting Scope or Accuracy

A liability assessment report must document and summarize, in a distinct section, any deviation from the specified assessment standard or conditions that materially limited the scope of the assessment or the accuracy of the cost estimate. This includes the availability of historical information, personnel familiar with the history of the site, and site conditions, such as snow cover and access to the subsurface.

If historical site information is lacking or the assessment is otherwise impeded, an appropriate contingency amount must be included as a distinct item in the cost estimate. The methods used to search for the missing data or conduct the on-site assessment must be described and the rationale provided to substantiate the contingency amount included.

6.2 Noncompliance Conditions

In accordance with *CSA Z769-00* specifications, the assessment report must list conditions that are believed to contravene regulatory requirements and that may affect suspension, abandonment, or reclamation costs. The licensee or approval holder is required to promptly respond to noncompliance conditions and develop an action plan to restore and ensure continued compliance.

6.3 Roles and Qualifications of Personnel

A liability assessment submitted to the ERCB for consideration must be based on a site assessment conducted only by appropriately trained and experienced personnel. The assessment report must clearly document, in a distinct section, the specific role of all personnel involved, their technical training, and their previous experience conducting assessments and developing cost estimates.

The assessment must be supervised and signed by a lead assessor who has completed post-secondary education in a directly related discipline and has prior experience estimating site-specific costs for suspension, abandonment, or reclamation. The lead assessor must also be a member in good standing of an association regulated by a professions or societies act of Alberta or be certified in Canada to conduct environmental site assessments by an agency that provides a comparable degree of professional accountability. This includes, but is not limited to, appropriately trained and experienced members of the Alberta Institute of Agrologists, Alberta Society of Engineering Technologists, Alberta Society of Professional Biologists, Association of the Chemical Profession of Alberta, Association of Professional Engineers, Geologists and Geophysicists of Alberta, and College of Alberta Professional Foresters.

6.4 Certification of Work

The signatory statement must stipulate that the report was completed in accordance with the specified standard(s) and that the report clearly documents all conditions that materially limit the scope of the assessment or the accuracy of the cost estimate. A statement limiting the use of the report by other parties will be accepted if the ERCB and ESRD are specifically cited as authorized users of the report.

The lead assessor must certify that he or she has prepared or supervised the liability assessment and placed his/her professional seal or stamp, as applicable. The report must be signed by the professional and include his/her professional designation or certification.

7 Submitting an Existing Liability Assessment

If a previously conducted liability assessment is submitted to the ERCB for consideration, it must meet the requirements specified in this directive, be less than three years old, and be accompanied by an evaluation of cost changes since the site assessment was completed. Factors to be considered when updating existing liability assessments include changes in site conditions, unit rates used in estimating costs, and regulatory requirements.

8 Use of a Liability Assessment

Upon receipt, the ERCB will review a liability assessment in relation to the requirements specified in this directive. If significant deficiencies are noted, the licensee or approval holder will be required to revise the assessment by a date specified by the ERCB.

Once a liability assessment for sites included within the scope of the Orphan Fund is accepted by the ERCB, it will be used to adjust the deemed liability applied in the LLR calculation.

For oilfield waste management facilities, once they are accepted by the ERCB, a site-specific liability estimate will be used to determine financial security requirements. The required frequency to update a liability assessment for an oilfield waste management facility will be determined by the ERCB and depend on site conditions and changes to the facility.

The current licensee or approval holder is responsible for ensuring that a liability assessment provided to the ERCB is updated according to the schedule specified by the ERCB. A liability assessment not kept up to date may result in the deemed liability reverting to typical costs or, for potential problem sites, ERCB enforcement action.

A site-specific liability assessment provided to the ERCB by a licensee or approval holder is intended only for the use of the licensee or approval holder, the ERCB, and ESRD. A licensee or approval holder submitting a liability assessment to the ERCB for consideration should be aware that submissions to the ERCB may be subject to public disclosure. The ERCB is not responsible to third parties for the completeness or accuracy of a liability assessment submitted to the ERCB for review.

9 Updates to Site-Specific Liability Assessment Cost Estimates

Unless otherwise required more frequently by the ERCB, licensees must provide updated site-specific liability assessment cost estimates five years from the date of the last site-specific liability assessment. Using the appropriate Facility Liability Declaration Form, licensees must submit these updates in hard copy and electronic copy (to LiabilityManagement@ercb.ca) and through the Digital Data Submission System.

The ERCB may require more frequent updates of site-specific liability assessment cost estimates

- at the time of a licence transfer request,
- upon audit of a licence,
- if site conditions warrant an update,
- if an ERCB requirement specifies an earlier submission deadline, or
- if the ERCB determines that circumstance warrant an update.

Appendix 1 Tasks for Estimating Site-Specific Costs

The following tasks are typically considered by the ERCB when reviewing a site-specific liability assessment submitted by a licensee or approval holder. In general, the greater the complexity, duration, or estimated cost of the anticipated work, the greater the level of detail expected in the cost estimate.

A1.1 Estimating Project Management and Administration Costs

Costs for project management and administration tasks should be provided for in all projects.

A1.1.1 Project Management

- initial planning
- regulatory applications and approvals
- on-site supervision
- reporting
- overall project coordination

A1.1.2 Project Administration

- subcontractors and third-party services
- equipment rental
- consumable supplies (e.g., safety supplies)
- mobilization time and travel expenses
- subsistence

A1.2 Estimating Suspension Costs

A1.3 Well Suspension

- maintaining, replacing, or retrofitting the wellhead as required
- installing and maintaining downhole equipment
- introducing and maintaining the level of wellbore fluids as required
- testing wellhead and casing integrity, repairing as needed
- conducting initial and follow-up lease inspections
- providing site security

A1.4 Facility Suspension

- removing and transporting all product, chemical, and oilfield waste inventories to ERCB- or ESRD-approved facilities
- securing the site, all buildings, and equipment to prevent unauthorized access or use
- providing weekly on-site security inspections and monthly reporting to the ERCB
- maintaining all required monitoring and reporting programs
- maintaining utilities, such as electrical power, water, and natural gas
- maintaining vegetation control
- winterizing the facility and related infrastructure

A1.5 Pipeline Suspension or Discontinuation

- physically isolating or disconnecting the pipeline from any operating well or facility
- cleaning the pipeline, if necessary
- purging the pipeline with fresh water, air, or inert gas
- maintaining corrosion control measures

A1.6 Estimating Abandonment Costs

A1.6.1 Well Abandonment

- removing all downhole equipment, such as rods and tubing
- abandoning all completed formations
- testing for and eliminating surface casing vent flow and gas migration
- disposing of any remaining drilling waste contained in on-site and remote sumps
- protecting groundwater
- conducting the surface abandonment

A1.6.2 Facility Abandonment

- identifying dangerous materials (e.g., asbestos and natural occurring radioactive materials) and developing management plans
- shutting down, draining, and purging all lines, vessels, and ponds
- testing pond liquids and sludge
- removing and transporting product, dangerous goods, and oilfield waste for off-site management
- dismantling and removing all equipment, vessels, structures, and utilities
- removing or disposing of pads, berms, ponds, foundations, piles, concrete, and other base and surfacing materials
- abandoning or removing pipe
- removing utilidors and cathode beds (where required)

A1.6.3 Pipeline Abandonment

- reviewing files and locating the line
- removing aboveground structures
- physically isolating or disconnecting the pipeline
- cleaning, if necessary
- purging with fresh water, air, or inert gas
- addressing residual contamination from spills
- plugging or capping all open ends
- intermediate cut and blocking (as required)
- removing underground pipelines where required

A1.7 Estimating Reclamation Costs

Reclamation includes both remediation and surface reclamation tasks.

A1.7.1 Remediation

- for each distinct area of the site requiring decontamination,
 - delineating the lateral and vertical extent of soil and underlying material containing regulated substance(s) in excess of applicable guidelines or criteria
 - estimating the volumes of affected and unaffected materials that would require excavation
 - excavating time and costs (excavator type, estimated time for excavation, cost per unit time, mobilization and demobilization costs)
 - characterizing affected materials for disposal or treatment (cost per sample, number of samples)
 - conducting confirmatory sampling (cost per sample, number of samples)
- transporting waste and disposing of it off site (mass of affected soil and subsoil, volume of liquid waste or affected water, number of shipments, transportation distance, transportation and disposal unit rates, and transportation and disposal cost subtotal), or characterizing the waste and treating it on site (volume of affected soil and subsoil to be treated, area available for land treatment, contaminant loading rates, treatment capital costs, treatment operating costs per year, estimated duration of treatment, and on-site waste treatment cost subtotal)
- treating and monitoring groundwater and/or bedrock contamination that cannot be excavated (volume of affected material, treatment capital costs, treatment operating costs per year, estimated duration of treatment, monitoring costs, confirmatory sampling, groundwater, and/or bedrock treatment costs subtotal)
- replacing and compacting backfill (volume required, costs to purchase, transport, replace, and compact, and backfill cost subtotal)
- miscellaneous expenses, such as safety supplies and vehicle use

A1.7.2 Surface Reclamation

- recontouring and stabilizing slopes
- addressing any soil structure, soil sterilant, hydrophobicity, and similar issues
- removing gravel and other surface materials
- replacing topsoil
- restoring surface drainage patterns
- planting, maintaining, and monitoring vegetation (fertilizing and weed control)
- preparing a detailed site assessment
- where applicable, participating in the reclamation certificate process

Appendix 2 Requirements for Site-Specific Liability Assessments for the Large Facility Liability Management Program

A2.1 Introduction

This appendix to *Directive 001* outlines the process and minimum reporting requirements for site-specific liability assessments used for *Directive 024: Large Facility Liability Management Program* and for large gas plants as defined in *Directive 006: Licensee Liability Rating (LLR) Program and Licence Transfer Process*.

When the licensee has completed a Type A liability assessment (see *Directive 024*, Section 6.4) meeting all of the requirements in this document, the forms at the end of this appendix must be submitted to the ERCB for review and acceptance of a site-specific liability cost estimate. Note that the ERCB will only accept site-specific assessments and will not accept general field evaluations of multiple facilities.

The ERCB will audit site-specific liability assessments at any time to ensure that the requirements of this directive are met.

The ERCB expects all licensees and lead assessors to follow appropriate environmental site assessment standards and use sound professional judgement in estimating potential costs to completely suspend and abandon a facility and remediate and reclaim all affected areas. A complete liability assessment must consist of the following:

- 1) suspension plan,
- 2) abandonment plan,
- 3) Phase I environmental site assessment,
- 4) Phase II environmental site assessment(s),
- 5) remediation plan,
- 6) surface reclamation plan, and
- 7) estimated costs for completing suspension, abandonment, remediation, and reclamation of the site.

Facility liability estimates must be based on a closure endpoint that meets ERCB facility suspension and abandonment requirements and remediation and surface reclamation to a state that meets Alberta Environment and Sustainable Resource Development (ESRD) reclamation certificate requirements.

A2.2 Suspension and Abandonment

The evaluation of suspension and abandonment costs must consider all tasks associated with purging, dismantlement, and removal and/or demolition of all equipment and associated infrastructure on site. Facility abandonment refers to the dismantlement, demolition, and removal of all buildings, structures, equipment, vessels, and on-site piping in accordance with ERCB requirements. Abandonment cost estimates must include the removal of all produced liquids, the removal of associated equipment and structures, and the removal and appropriate disposal of structural concrete. Abandonment cost estimates must not include any credit or discount for salvage value for the purpose of the liability management program.

The Suspension and Abandonment Cost Estimate Summary (Form 001-A) must be completed and submitted to the ERCB. If different assumptions or methods for estimating suspension

and abandonment costs were used, a detailed explanation of methods and assumptions applied must be documented and submitted.

A2.3 Phase I Environmental Site Assessment

As stated in *Directive 001*, the basis for a site-specific liability assessment must be a Phase I environmental assessment that meets or exceeds ESRD guidelines provided in publication T/573. Licensees must also update and submit the Facility Summary Form (Form 001-D). In addition to adhering to all requirements in the ESRD guidelines, licensees are expected to consider the following in their assessment:

- decommissioned and current sulphur block storage and runoff treatment ponds,
- sulphur inventory and condition of shipping areas,
- waste handling and condition of on-site waste treatment, disposal, and storage sites,
- current and historical tanks, and
- all affected areas (including off site).

A2.4 Phase II Environmental Site Assessment

Issues identified in the Phase I investigation must be evaluated, characterized, and quantified using a Phase II environmental site assessment(s) that meets or exceeds CSA Z769-00. If existing site assessment work does not meet these standards, lead assessors must conduct additional investigation or identify and evaluate the deficiency(ies) and provide a sufficient contingency budget (with justification) to address the issues likely to be deficient.

The results of the Phase II environmental site assessment are to be used to develop a proposed remediation plan sufficient to estimate soil and groundwater remediation costs. They should also be used to determine the surface reclamation costs.

A2.5 High-Level Overview for Using Phase II Investigations

In using environmental information from Phase II assessments for estimating liabilities, the lead assessor must ensure that

- all potential sources of contamination or surface disturbance are investigated according to the specified standards and standard industry practice,
- boundaries of plumes are established to a reasonable degree and the volumes of affected soil and unaffected soil overburden are estimated,
- groundwater impacts are appropriately quantified and, where possible, temporal trends are determined, and
- contaminant issues are sufficiently quantified and characterized to permit development of remediation plans for the purposes of estimating associated costs.

A2.6 Soil Volume Plume Determination for Accessible Areas

The following are minimum requirements to estimate soil remediation costs where intrusive investigation can be conducted:

- 1) All sides of the plume(s) must be delineated. Accepted geophysical or other tools can be used to reduce the amount of intrusive work required for delineation—but ground-truthing, using intrusive soil and groundwater sampling methods, is required to validate those findings.
- 2) Vertical and horizontal delineation of soil plumes must include borholes, test pits, or other intrusive sampling results, as required, to demonstrate reasonable delineation of

plume dimensions. This must include boreholes showing background chemistry conditions to confirm that the leading edges of the plume have been established.

- 3) A reasonable number of boreholes are required in the plume area to characterize the most concentrated effects. In addition, professional judgement must be applied to interpret any temporal trends.
- 4) Based on the assessment of soil and groundwater chemistry, a polygon diagram is to be created to represent the surface expression of the plume. Geology, groundwater flow, contaminant source, and other factors should be considered when creating this shape.
- 5) The results of vertical delineation from the intrusive sampling are then applied to produce three-dimensional polyhedrons of affected soil and, where applicable, unaffected soil overburden. The polyhedrons may be subdivided as needed to estimate volume. The volumes of all subpolyhedrons are then totalled as a preliminary estimate of affected and unaffected soil volumes.
- 6) Professional judgement must be applied to adjust preliminary soil volume estimates to account for the irregular and curvilinear nature of plume boundaries (plume fingers). The plume irregularity factor or similar methodology used to estimate in situ soil volumes must be documented and the basis for it provided.
- 7) A second, distinct excavation-bulking factor must be applied to the estimated in situ soil volumes to account for the increase in volume when naturally compacted soil is excavated. While professional judgement may be applied when estimating this excavated soil volume, experience has shown that the volume of soil typically increases between 1.2 and 1.4 times when excavated. The basis for the excavation-bulking factor must be documented and any deviation from the range provided must be substantiated.
- 8) A third soil density factor may be required if remediation planning requires assessment of costs using soil mass. To convert the estimated excavated soil volumes to estimated soil mass, a site-specific assessment of bulk density must be applied. Alternatively, in situ soil density can be measured and applied to the in situ soil volume estimates to directly estimate soil mass.
- 9) Topsoil and unaffected subsoil (overburden) volumes requiring handling during remediation must be estimated as described above. Specific requirements for including clean overburden and topsoil are discussed in Section 4.4.
- 10) Where on-site treatment of affected soils is proposed, a description of the approach and infrastructure needed, the assessment of site suitability, results of soil treatability testing, and the rationale used to predict duration of treatment must be provided.

A2.7 Estimating Affected Soil Volumes If Site Structures Do Not Allow Safe Work

In most cases, proper planning and procedures can permit the objectives of a site assessment to be accomplished safely. In situations where safety concerns legitimately restrict the scope of a site assessment, the lead assessor must document the rationale for the restricted scope of work and provide sufficient budget contingency to address the remediation and reclamation costs reasonably expected for the areas not assessed. The contingency allocated for likely but unconfirmed issues in areas not assessed must be distinct from the contingency provided to address uncertainty in estimating the costs of confirmed issues.

On active sites, safety concerns related to buried infrastructure may make complete plume delineation through intrusive surveys impossible. In each instance where complete plume delineation is not possible, licensees must develop an appropriate estimate of potentially affected soil volumes and area requiring remediation using information from other sources and professional experience.

Where complete delineation is not possible, alternative sources of information need to be considered. These may include

- findings of the Phase I environmental site assessment,
- prior experience at comparable sites,
- regional information and site information collected prior to construction,
- partial or limited intrusive assessments,
- assessments from the periphery of the site, and
- nonintrusive investigative methods that are not affected by the buried infrastructure.

The remediation and reclamation plan used to estimate costs in areas where complete plume delineation is not possible must document the considerations taken into account and the assumptions used to estimate costs. An explanation for each factor listed below is required, including an explanation of the site-specific condition, the related assumptions, and how they were factored into the volume estimate. A sketch of the plume overlaid on the site drawing showing the sample points must accompany the volume estimate. As a minimum, the following factors must be considered when estimating soil remediation costs:

- **area of facility** not included in intrusive sample, particularly the potential for off-site adverse effects;
- **site geology**—surface to bedrock, including the expected rate of contaminant migration through subsoil and bedrock, and any results of previous soil sampling;
- **topography**—strong or weak control on contamination migration;
- **site history**—site age, contaminant sources no longer evident, building floors, earthen pits, etc.;
- **parameters of concern**—salt, produced hydrocarbon, amines, pH, metals, glycols, methanol, lubricating oils, sulphur, degreasers, and any degradation products that represent a significant environmental risk;
- **known and suspected contaminant issues**—condition of pond liners, status of any former sulphur pad treatment;
- **groundwater**—depth to and extent of affected aquifer, seasonal variation of the water table, and where required, depth to deeper aquifers, communication between aquifers, groundwater flow direction, and estimated flow velocity for each aquifer assessed; and
- **receptors**—surface water, sensitive sites, and aquifers connected to water table, etc.

A2.8 Unaffected Overburden and Topsoil

The liability estimate must distinguish and separately report the costs to handle unaffected overburden and topsoil from costs to import backfill to replace soil disposed of off site. Costs for the former include stripping and stockpiling of material to be reused while imported backfill must be purchased and trucked to the site. Both estimates must consider the need to replace and mechanically compact the fill and re-establish topsoil depths. As well, additional soil replacement to ensure materials balance should be accounted for in surface reclamation costs.

A2.9 Groundwater Issues

In most cases of significant soil contamination, groundwater is adversely affected by contamination and must also be remediated. Groundwater treatment alone may not result in sufficient remediation if residual soil contaminants continue to be reintroduced into groundwater.

To meet ESRD requirements to obtain a reclamation certificate, estimates of groundwater remediation costs must be based upon a remediation plan that first includes contaminant source removal. Where removal of all affected soil or bedrock is not technically reasonable, groundwater remediation costs must be based on a plan to remove all accessible soil in excess of criteria or objectives and operate an active groundwater remediation system until remediation is complete. Cost estimates must distinguish the installation and operating costs of groundwater remediation systems and provide the basis for estimating the duration of treatment and monitoring required.

A2.10 Groundwater Plume Determination

The following are minimum requirements to estimate groundwater remediation costs:

- 1) All sides of the plume(s) must be delineated as described previously for quantifying affected soil volumes.
- 2) If groundwater contamination of the uppermost aquifer is apparent, an assessment of the next lower water-bearing zone must be conducted. This includes communication between aquifers and characterization of the lower groundwater quality and flow characteristics.
- 3) Polygons representing the aerial extent of the aquifer requiring treatment and groundwater requiring monitoring are to be developed.
- 4) The volume of groundwater requiring treatment or monitoring must be estimated.
- 5) The duration of groundwater treatment or monitoring required and the total volume of groundwater to be treated must be estimated.

When planning groundwater remediation, many factors affect the design and operation of even a simple pump and treat system. Thorough assessment of groundwater and aquifer conditions requires that an effective groundwater monitoring system be installed and allowed to stabilize prior to sampling. In addition to characterization of groundwater flow and quality, additional contaminant characterization, including contaminant treatability testing, is generally required. Use of commonly accepted hydrogeological software is highly recommended to estimate the expected volume of affected groundwater requiring treatment and the length of time required for remediation.

Along with a groundwater remediation cost estimate, an explanation must be provided of how the following were considered to estimate the volume of affected groundwater and duration of treatment expected:

- **aquifer properties** (depth to affected groundwater table, communication with deeper aquifers, heterogeneity, permeability);
- **soil properties** (texture, permeability, heterogeneity, depth to bedrock);
- **groundwater properties** (quality, depth, flow velocity, seasonal variability);
- **precipitation and climate** (seasonal temperatures, restrictions to equipment operation, rain and snow fall, net water flow);
- **groundwater users** (proximity and potential effects on residents, dugouts, surface water bodies);

- **contaminant sources and environmental fate** (solubility, viscosity, density, reactivity, persistence, sorption potential [K_{oc}], treatability, formation of intermediary degradation products); and
- **known or suspected contaminant issues** (concentrations in relation to criteria or site-specific remediation objectives, temporal trends in contaminant concentrations, extent of plume, prediction of plume migration).

A2.11 Remediation Plan

A plan to address the contaminant issues identified in the Phase I and Phase II environmental site assessments must be developed in order to estimate remediation costs. The plan must distinguish soil treated on site and disposed off site. A site-specific treatability study should be conducted for proposed on-site treatment to demonstrate effectiveness of the proposed remediation technique on specific contaminants. Groundwater remediation must describe contaminant source removal, the remediation approach applied, and the basis for estimating duration of treatment.

Factors that must be considered in developing a remediation plan for large facility sites, include, but are not limited to,

- contaminants and properties (solubility, density, treatability, reactivity),
- soil types and properties (heterogeneity, permeability, porosity),
- water/aquifer properties (depth, flow rate, groundwater table),
- climate factors (precipitation, snowfall, seasonal net water flow, drought), and
- remediation criteria or site-specific remediation objectives (site and regional characteristics, contaminant form, fate and transport, and environmental risk).

The remediation plan must set objectives to meet ESRD reclamation criteria. If it is not technically feasible to obtain Tier I closure on the site, a screening assessment as per the Canadian Council of Ministers of the Environment's "A Framework for Ecological Risk Assessment: General Guidance" (1996) must be completed to demonstrate that an alternative closure endpoint is appropriate. This screening assessment must document receptor characterization, exposure assessment, hazard assessment, and risk characterization, at a minimum.

A complete detailed remediation plan is required as part of the site-specific liability assessment. This plan will require updates in response to changes over time in plume dimensions, contaminant characteristics, and potential receptors. An assessment of predicted plume changes and a proposed schedule to update the remediation plan in response to those changes must also be documented.

A2.11.1 Conversion of Affected Soil and Groundwater Volumes to Remediation Cost

Estimated volumes requiring remediation and the expected duration of treatment must be used to estimate soil and groundwater remediation costs. In addition to initial capital costs for installation and commissioning an on-site remediation system, operating and maintenance costs must be estimated for the full expected duration of treatment or monitoring. To that end, the cost estimate for remediation must include

- type of remediation system (e.g., bio-cell, drainage tile, vertical wells, horizontal wells),
- dimensions of system (e.g., length of trench, number and depth of wells),
- installation costs, including system infrastructure (e.g., piping, electrical, buildings),

- duration of operational treatment time predicted,
- water disposal/treatment costs on an annual basis multiplied by duration of treatment predicted,
- operation and monitoring costs,
- system abandonment costs, and
- any other life-cycle costs, such as project management, utilities, taxes, insurance, and lease payments.

A2.12 Summary of Documents to Be Submitted to ERCB

Once a licensee has completed a site-specific liability assessment meeting all of the requirements detailed in this document, all forms specified below must be provided to the ERCB for review and acceptance of the site-specific liability cost estimate.

The supporting data and environmental site assessment reports are subject to ERCB audit at any time to ensure that all requirements in this directive are met.

Form	Title
001-A	Suspension and Abandonment Cost Estimate Report
001-B	Large Facility Remediation and Reclamation Cost Estimate Report
001-C	On-site Reclamation and Remediation Details
001-D	Facility Summary
001-E	Suspension and Abandonment Acknowledgement Statement for Large Facility Liability Assessments
001-F	Reclamation and Remediation Acknowledgement Statement for Large Facility Liability Assessments

These forms follow on the next pages.

FORM 001-A Suspension and Abandonment Cost Estimate Report

ERCB Licence Number					
Facility Type (Guide 56, Table 5.1)					
LSD Location					
Licence Holder					
Facility Name					
Demolition Costs Description	Quantities	Units	Unit Costs	Units	Costs (\$)
Facility Suspension (purge vessels, flow lines)					
Facility Preparation (electrical/instrumental disconnect)					
Concrete Demolition		t		\$/t	
Structural Demolition		t		\$/t	
Building Demolition		t		\$/t	
Equipment Demolition		t		\$/t	
Vessels Demolition		t		\$/t	
Aboveground Piping Demolition		t		\$/t	
Belowground Facilities (piping/tanks) Demolition		t		\$/t	
Asbestos (% of incremental cost or tonnes if available)		% or t		\$/t	
Asbestos - piping insulation		t		\$/t	
Asbestos - building insulation		t		\$/t	
Road/Rail/Airstrip Removal		m		\$/m	
Other Costs (re-route active lines)					
Demolition Subtotal					
Transportation and Disposal					
Class I Landfill					
Disposal Fee		t		\$/t	
Transportation and Loading Cost		km		\$/km	
Class II Landfill					
Disposal Fee		t		\$/t	
Transportation and Loading Cost		km		\$/km	
Class III Landfill					
Disposal Fee		t		\$/t	
Transportation and Loading Cost		km		\$/km	
NORM Disposal					
Disposal Fee		t		\$/t	
Transportation and Loading Cost		km		\$/km	
ESRD Licensed Incineration					
Disposal Fee		t		\$/t	
Transportation and Loading Cost		km		\$/km	
Liquids Disposal (from Facility Suspension)					
Disposal Fee		m ³		\$/m ³	
Transportation and Loading Cost		km		\$/km	
Other Disposal					
Disposal Fee		t		\$/t	
Transportation and Loading Cost		km		\$/km	
Scrap Metal Value					
Sorting and Sizing Cost		t		\$/t	
Transportation and Loading Cost		km		\$/km	
Ferrous Material Value		t		\$/t	
Nonferrous Material Value		t		\$/t	
Scrap Metal Net					-
Transportation and Disposal Subtotal					

(continued)

FORM 001-A Suspension and Abandonment Cost Estimate Report (concluded)

Project Management	Quantities	Units	Unit Costs	Units	Costs (\$)
Project Management Services		%		\$	
Project Engineering and Supporting Services					
Site Admin. Costs (supervision, safety, utilities, trailers, taxes, etc.)		%		\$	
Project Management Subtotal					
Contingency		%		\$	
Total Suspension and Abandonment Cost					
Note that there should be material balance between demolition and transportation/disposal, exclusive of disposal of materials associated with suspension (catalyst, chemicals, sludges, etc.).					

FORM 001-B Large Facility Remediation and Reclamation Cost Estimate Report

ERCB Licence Number					
Facility Type (Guide 56, Table 5.1)					
LSD Location					
Licence Holder					
Facility Name					
	Quantities	Units	Unit Costs	Units	Costs (\$)
On-Site Remediation					
In Situ Soil Remediation		m ³		\$/m ³	
Ex Situ Soil Remediation					
Land Treatment		t		\$/t	
Biocell/Biopile		t		\$/t	
Thermal (on-site or mobile incineration)		t		\$/t	
Landfill (on-site)		t		\$/t	
Other (specify: _____)		t		\$/t	
Groundwater (installation, monitoring, and remediation)		m ³		\$/m ³	
Surface Water		m ³		\$/m ³	
Backfilling (purchase, hauling, replacement, compaction)		t		t	
Analytical (delineation, confirmatory, waste characterization)					
On-Site Remediation Subtotal					
Off-Site Disposal					
Class I Landfill					
Excavation and Loading Cost		t		\$/t	
Disposal Fee		t		\$/t	
Transportation Cost		km		\$/km	
Class II Landfill					
Excavation and Loading Cost		t		\$/t	
Disposal Fee		t		\$/t	
Transportation Cost		km		\$/km	
Class III Landfill					
Excavation and Loading Cost		t		\$/t	
Disposal Fee		t		\$/t	
Transportation Cost		km		\$/km	
Incineration					
Excavation and Loading Cost		t		\$/t	
Disposal Fee		t		\$/t	
Transportation Cost		km		\$/km	
Other Disposal					
Excavation and Loading Cost		t		\$/t	
Disposal Fee		t		\$/t	
Transportation Cost		km		\$/km	
Off-Site Transportation and Disposal Subtotal					
Reclamation					
Decompaction		ha		\$/ha	
Contouring		ha		\$/ha	
Topsoil (stripping, hauling, screening, all soil replacement)		ha		\$/ha	
Revegetation (seeding, monitoring, weed control)		ha		\$/ha	
Reporting (including reclamation certificate application)				\$	
Reclamation Subtotal					

(continued)

FORM 001-B Large Facility Remediation and Reclamation Cost Estimate Report (concluded)

	Quantities	Units	Unit Costs	Units	Costs
Project Management					
Project Management Services		%		\$	
Project Supporting Services		%		\$	
Site Administrative Costs (supervision, safety, taxes, utilities, trailers, etc.)		%		\$	
Project Management Subtotal					
Contingency		%		\$	
Total Remediation and Reclamation Cost					

FORM 001-C On-Site Reclamation and Remediation Details (for waste treatment only; excludes off-site disposal methods)

ERCB Licence Number										
Facility Type (Guide 56, Table 5.1)										
LSD Location										
Licence Holder										
Facility Name										
	Process Area (Location)	Affected Volume ¹	Contaminant Types	Media Characteristics	On-Site Treatment Method	Remediation Timeframe	Treatment Cost		Total Operation & Maintenance	
	(general area requiring remediation)		(list main contaminants)	Soil Type, Aquifer Type, Groundwater Depth			Excavation	Treatment System Cost ²		Unit Cost
		m ³ or t				(months)	(\$)	(\$)	(\$)	(\$/m ³)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

¹ Affected volume units should be in m³ for water treatment and affected mass in tonnes for soil treatment. Apply bulking factor for ex situ treatment, as described in *Directive 001*, Appendix 2.

² Treatment system costs should include cost to construct and/or implement treatment system, as well as sampling and analytical costs.

FORM 001-D Facility Summary

The purpose of this form is to provide summary information on the facility. This information will be used internally by the ERCB as part of the process to track liabilities and conduct audits. Complete supporting documentation for information contained in the form and the attachments must be made available to the ERCB upon request.

Information must be updated when significant changes occur. Full information must be available prior to the transfer of a property, when a facility is shut down, or upon request by the ERCB.

General Information

Licensee
Plant Location
ERCB Licence #
Plant Name
Initial Construction Year
Describe Major Expansion(s) and Year(s)
Does licensee own land?

Complete Attachment 1

Maximum * Design Capacities

Raw Gas Inlet ($10^3 \text{ m}^3/\text{d}$)

Sulphur Inlet (t/d)

NGL Products

Ethane (m^3/d)

Propane (m^3/d)

Butane (m^3/d)

NGL (m^3/d)

or NGL Mix

C5+ design (m^3/d)

Other Sales Products (specify)

Oil Feedstock (m^3/d)

Bitumen Inlet (m^3/d)

Diluent Inlet (m^3/d)

Sand Production (t/d)

Waste Products

Has a hazardous materials survey been conducted for the following? If yes, complete attachment 2. If no, explain why.

Asbestos

Mercury

PCBs

Naturally Occurring Radioactive Materials (NORM)

List of Amines Used Over Life of Plant (MEA, MDEA, DEA, Sulfolane, DIPA,

Sulfinol, other (specify)

List of Glycols Used Over Life of Plant

Complete Attachment 2

Equipment

Liquid Recovery Type (Refrig, Lean Oil, JT, Turbo Expander)

Number of Pressure Vessels (any with an ABSA A#)

List of Tanks, Including Content and Volume

List of Sumps (total volume m^3)

Number of Engines over 75 kW

Total Compression (in kW)

Electrical kW

Gas Driven kW

Plant Air Photo (most detailed scale available), Major Equipment List and Plot Plan

Complete Attachment 3

Complete Attachment 4

Complete Attachment 5

(continued)

Pits and Ponds (active, inactive, historical and buried)

All Pits/Ponds (attach description for each pond—volume, age, liner type, contents and associated GW issues and whether remediation is complete)	Complete	Attachment 6
Number of Sanitary Sewage Lagoons (total containment volume m ³)		
ERCB approval number for any oilfield waste landfills on site. Are there any landfills, closed or open/active on site? If yes, complete Attachment 7.	Complete	Attachment 7

Sulphur Processing and Storage

Sulphur forming on site? Type of sulphur recovery process?		
Describe all sulphur forming methods and capacity present (prill, slate, rotoform, other)	Complete	Attachment 8
Area of unlined sulphur base pad that has had block and has not been reclaimed (m ²)		
Assumed depth of sulphur impact (m)		
Area of lined sulphur base pad that has had block and has not been reclaimed (m ²)		
Type of liner on sulphur pad		
Type of liner on sulphur block runoff ditch		
Contaminated (off-spec) sulphur inventory (t)		

Environmental

Describe any high-volume waste production (e.g., kg/d of produced sand, lime sludge, produced water) and method and location of disposal	Complete	Attachment 9
Describe all off-site impacts from the operation of the facility, including those currently outstanding, undergoing treatment, or where remediation and/or reclamation is completed (e.g., sulphur dusting, groundwater plume, spills)	Complete	Attachment 10
Describe all on-site completed and ongoing remediation projects (soil, surface water, and groundwater)	Complete	Attachment 11
Provide a geology overview, including overburden	Complete	Attachment 12
Provide a hydrogeology overview for each groundwater-bearing zone	Complete	Attachment 13
Depth to domestic use aquifer (as applicable)		
Number of residents within 1 km from plant		
Number of water wells within 1 km radius		
Describe water body(s), including cattle dugouts, within 300 m	Complete	Attachment 14
Total disturbed area, including roads (hectares)		
Assumed exposure pathways used for cleanup and rationale for choice (optional)	Complete	Attachment 15
Are there any risk-based closure strategies employed in the facility suspension, abandonment, remediation, and reclamation estimate?	Complete	Attachment 16

FORM 001-D Attachments

Attachment 1 Describe major expansion(s), year(s), including capacity addition and purpose of expansion											
	Description of expansion										Year
Attachment 2 Description of any areas containing hazardous materials											
	Material			Location (indicate on separate plot plan)							Quantity (t)
Attachment 3 List of tanks, including content and volume											
	Tank ref. no./name	Tank content	UST or AST	Tank capacity (m ³)	Secondary containment	Details of failures on leak test	Period of active service	Year of construction	Double-walled? (Y/N)	Alarms on 2-hour facilities or high-level shutdowns	Meets Guide 55 for new tanks
Attachment 4 List of sumps (total volume m ³)											
	Sump ref. no./name	Sump content	Material of construction		Sump volume (m ³)		Liner type	Period of active service	Year of construction	Where does the sump drain to?	
Attachment 5 Air photo interpretation (include pit and pond details), equipment list, and plot plan											
	Year	Comments									

Attachment 6	All pits/ponds—attach description for each pond: volume (estimate where not available), age, liner type, contents, associated GW issues, and whether remediation is complete										
	Pond ref. no./name	Pond description/contents	Material of construction	Pond volume (m ³)	Liner(s) material	Period of active service	Year of construction	Surface area of pond	Aerial extent and type of GW Issues (m ²)	Volume and type of contaminated soil (m ³)	Current status (active, inactive, or decommissioned)
Attachment 7	For each landfill (open or closed): age, liner, capacity, contents, and description of any groundwater issues										
	Landfill ref. no./name	Landfill description/contents	Material of construction	Type of material and landfill volume (m ³)	Liner(s) material	Period of active service	Year of construction	Aerial extent and type of groundwater Issues (m ²)	Volume and type of contaminated soil (m ³)	Current status (active, inactive, or decommissioned)	
Attachment 8	Describe all forming methods and capacity present (prill, slate, rotoform, other)										
	Type of sulphur forming (prill, slate, rotoform, other [specify])				Forming design capacity (t/d)				Years of service		
Attachment 9	Describe any high-volume waste production (kg/d) and method and location of disposal (e.g., lime sludge)										
	Description of waste and source	Waste volume (kg/d)	Method of disposal	Waste receiver(s) and location(s)		Spill description (source and type of material)		Volume (m ³)	Date of spill		

Attachment 10	Describe all outstanding and former off-site impacts from the operation of the facility							
	Type of impact and furthest distance from lease (m)	Aerial extent, estimated volume of affected soil, and characterization of GW issues	Remediation method (contaminant type and treatment)	Volume and type of contaminated soil (m ³)	Treatment initiation (date)	Years to complete	Remediation method used	Remediation completion date
Attachment 11	Describe all completed and ongoing remediation projects							
	Remediation Project Area or description	Aerial extent, estimated volume of affected soil, and characterization of GW issues	Remediation method (contaminant type and treatment)	Volume and type of contaminated soil (m ³)	Treatment initiation (date)	Years to complete	Remediation method used	Remediation completion date
Attachment 12	Provide a geology overview, including overburden, and assess contaminant migration							
Attachment 13	Provide a hydrogeology overview and assess contaminant migration for each zone							
	Zone depth from surface (m)	Flow direction	Flow velocity (m/yr)	Hydraulic conductivity (m/s)	Hydraulic gradient (m/m)	Texture of aquifer (fine/medium/coarse)	Containment concentrations	Aerial extent of contamination

Attachment 14	Describe water bodies within 300 m							
	Name and description of water body	Distance to lease boundary (m)						
Attachment 15	Describe assumed exposure pathways used for cleanup and rationale for choice							
Attachment 16	Provide basis (technical data, assumptions, and analysis) for development of site-specific risk-based remediation objectives. If proposed land-use classification after remediation is different from original land use, provide evidence of stakeholder agreement (letters from landowner and/or local municipality)							

**FORM 001-E Suspension and Abandonment Acknowledgement Statement for Large
Facility Liability Assessments**

A liability assessment was prepared for (INSERT LICENSEE) for the (INSERT FACILITY NAME) facility located at (LSD) on (INSERT ASSESSMENT DATE). This declaration states that the assessment was executed in accordance with the following requirements:

Suspension and Abandonment

- ☐ The estimate of suspension and abandonment cost was based upon a site-specific evaluation of suspension and abandonment needs and completed according to standard engineering practice.

Qualifications of Personnel

The liability assessment was conducted only by appropriately trained and experienced personnel. Where specialized expertise was required, professionals in good standing with their respective accrediting bodies reviewed and certified that work within their scope of practice.

Factors Affecting Scope and Accuracy

In a separate section, the liability assessment report documents the conditions and data deficiencies that materially affect the scope or accuracy of the cost estimates provided. Discrepancies with the specified protocol were noted and, where applicable, a contingency budget was provided to ensure sufficient funds to address potentially significant liabilities that were not adequately evaluated.

Basis for Cost

The cost estimates provided are undiscounted current costs that include all tasks required to complete suspension and abandonment as specified by ERCB *Directive 001*.

Closure Statement

As the Lead Assessor, I certify that I am a member in good standing of the professional association indicated below and conducted this work according to applicable codes of ethics and standards of professional practice and as declared above.

Signature of Lead Assessor

Name (please print)

Professional Association
(stamp where applicable)

Date

**FORM 001-F Reclamation and Remediation Acknowledgement Statement for
Large Facility Liability Assessments**

A liability assessment was prepared for (INSERT LICENSEE) for the (INSERT FACILITY NAME) facility located at (LSD) on (INSERT ASSESSMENT DATE). This declaration states that the assessment was executed in accordance with the following requirements:

Phase I Environmental Site Assessment

- ☐ The initial environmental site assessment used for the liability assessment meets or exceeds the requirements specified in Alberta Environment and Sustainable Resource Development (ESRD) publication *T/573: Phase 1 Environmental Site Assessment Guideline for Upstream Oil and Gas Sites* (as amended), as well as the supplemental requirements specified in *ERCB Directive 001*.

Phase II Environmental Site Assessment

- ☐ The subsequent intrusive site assessment(s) used for the liability assessment has (have) sufficiently evaluated all of the issues identified in the initial site assessment in a manner that meets or exceeds *Canadian Standards Association (CSA) Standard Z769-00: Phase II Environmental Site Assessment* (as amended), as well as the supplemental requirements specified in *ERCB Directive 001*.

Remediation

- ☐ The remediation cost estimate is based on an appropriate remediation plan as specified in *Directive 001*. The remediation techniques used in this liability assessment have been proven to be effective in Alberta conditions and are expected to restore all surface and subsurface affected materials to current ESRD reclamation certification standards.

Reclamation

- ☐ The reclamation cost estimate was based upon a site-specific assessment of outstanding surface or land reclamation tasks that will be required to apply for a reclamation certificate.

Qualifications of Personnel

The liability assessment was conducted only by appropriately trained and experienced personnel. Where specialized expertise was required, professionals in good standing with their respective accrediting bodies reviewed and certified that work within their scope of practice.

Factors Affecting Scope and Accuracy

In a separate section, the liability assessment report documents the conditions and data deficiencies that materially affect the scope or accuracy of the cost estimates provided. Discrepancies with the specified protocol were noted and, where applicable, a contingency budget was provided to ensure sufficient funds to address potentially significant liabilities that were not adequately evaluated.

Basis for Cost Estimates

The cost estimates provided are undiscounted current costs that include all tasks required to complete remediation and reclamation as specified by *ERCB Directive 001*.

Use of the Report

The liability assessment was prepared for the use of (INSERT LICENSEE NAME), the Energy Resources Conservation Board, and Alberta Environment and Sustainable Resource Development.

Closure Statement

As the Lead Assessor, I certify that I am a member in good standing of the professional association indicated below and conducted this work according to applicable codes of ethics and standards of professional practice and as declared above.

Signature of Lead Assessor

Name (please print)

Professional Association
(stamp where applicable)

Date